DNV·GL

Taking a broader view

2015年4月24日　#26 海友フォーラム懇談会で紹介　　DNV GL 並川俊一郎

Henrik O. Madsen - DNV GL Group President & CEO

March 2015

50 minutes followed by 40 minutes Q&A

1. **DNV GL in brief – video and short facts**
2. **DNV GL Maritime**
3. **DNV GL Oil & Gas**
4. **DNV GL Energy**
5. **Five DNV GL development projects**
   - Offshore Hybrid Power Solutions
   - Offshore floating wind – including video
   - Digital technologies and automation – a catalyst for smarter shipping
   - Adaption to Climate Change
   - Standardization
6. **Summing up**

DNV GL – the video

Short facts about us

Industry consolidation

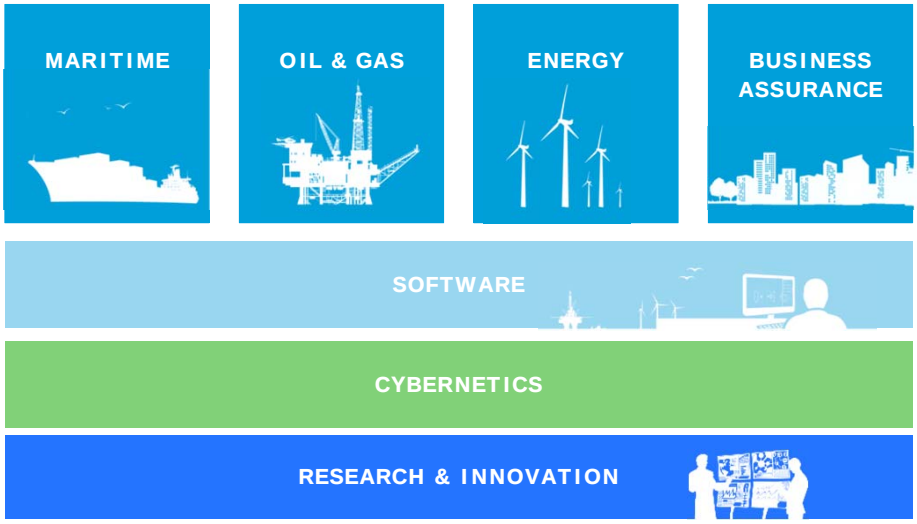
DNV·GL

DNV · GL Group · KEMA · NOBLE DENTON · GARRAD HASSAN · ADVANTICA

Global reach – local competence

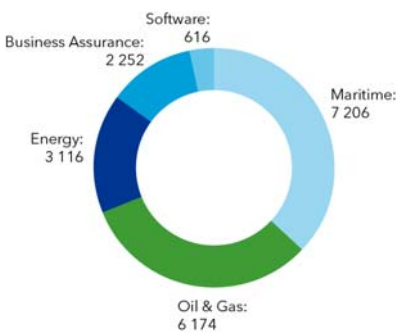
150	400	100	16,000
years	offices	countries	employees

Organized to maximise customer value

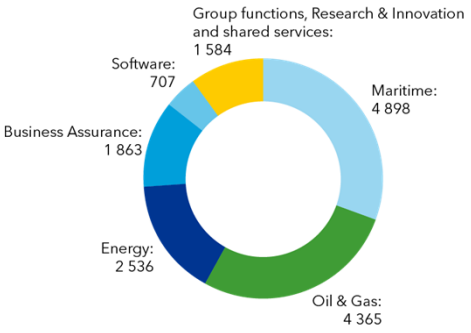


Revenue and people by business area / unit

Revenue:
20 000 Mill NOK



Employees:
16 000



Highly skilled people all around the world

Level of education

Master	42%
Bachelor	37%
Other	10%
Doctorate	6%
2-year college	3%
Technical / professional	2%
Sum: Bachelor, Master or PhD level degree	85%

Nationalities

EMPLOYEES BY NATIONALITY AS PER 31.12.2013

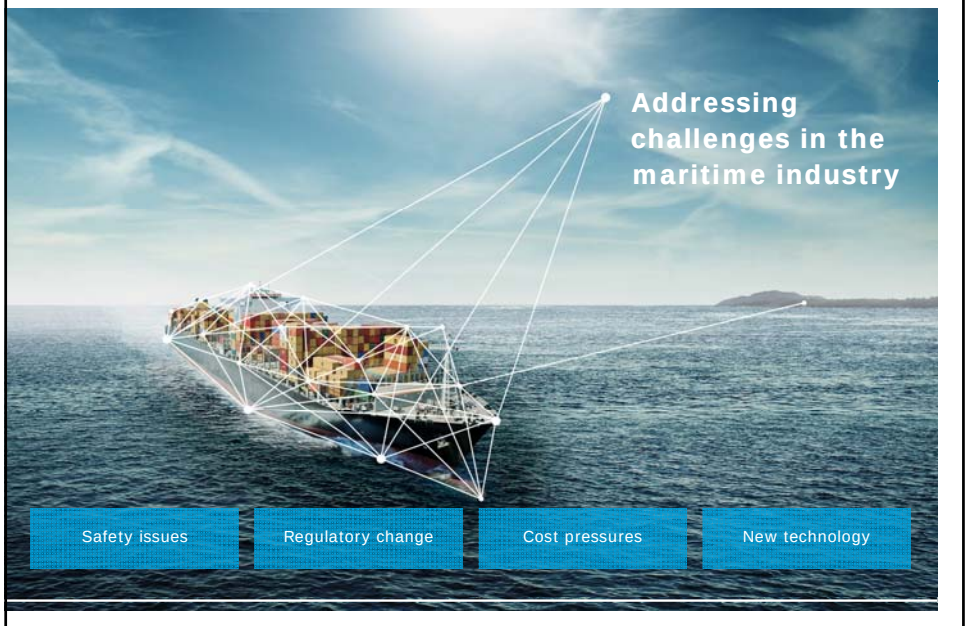
Norwegian	2,160	Danish	261
German	1,861	Singaporean	237
American	1,602	Spanish	205
British	1,336	Swedish	205
Chinese	1,143	French	173
Dutch	906	Egyptian	160
Indian	895	Canadian	153
Korean	468	Japanese	139
Italian	383	Greek	132
Brazilian	376	Russian	118
Polish	353	Mexican	113
Malaysian	265	Australian	103

Nationalities >100 shown in table
Nationalities >800 shown in pie chart

Committed to innovation

- Investing 5% of our revenue in research and innovation every year
- Collaborating with industry partners and external experts
- Sharing knowledge through standards and recommended practices
- Providing foresight and initiate competence building and innovation


MARITIME


Addressing challenges in the maritime industry
Safety issues
Regulatory change
Cost pressures
New technology

The world's leading ship and offshore classification society

Global reach
Survey stations in 100+ countries and expertise in all ship and offshore segments

13,000
ships and mobile offshore units in DNV GL Class, 270 mill GT

24 %
market share (Gross Tonne) of the world's classed ships and mobile offshore units

Quality
Consistently among the top ranking societies in Port State Control performance

Shipping has an impact on the society, economy and environment

Lives lost at sea
900
ship accident fatalities per year
Average 2003-2012

Freight cost
7-11%
of cargo value

Insurance claim cost
0.23%
of insured value
Average 2010-2012

Recycling
90%
of the ship recycled

Introduction of invasive species
20 000
marine organisms introduced per day

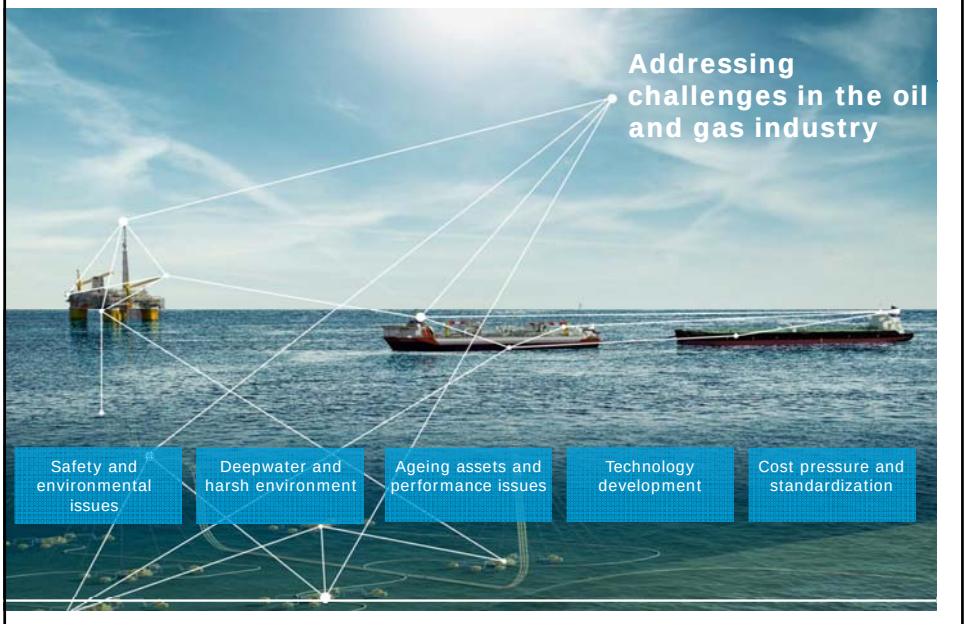
Accidental oil spills
5000
tonnes per year
Average 2010-2012

CO_2 emissions
900
million tonnes per year

NO_x emissions
22
million tonnes per year

SO_x emissions
12
million tonnes per year

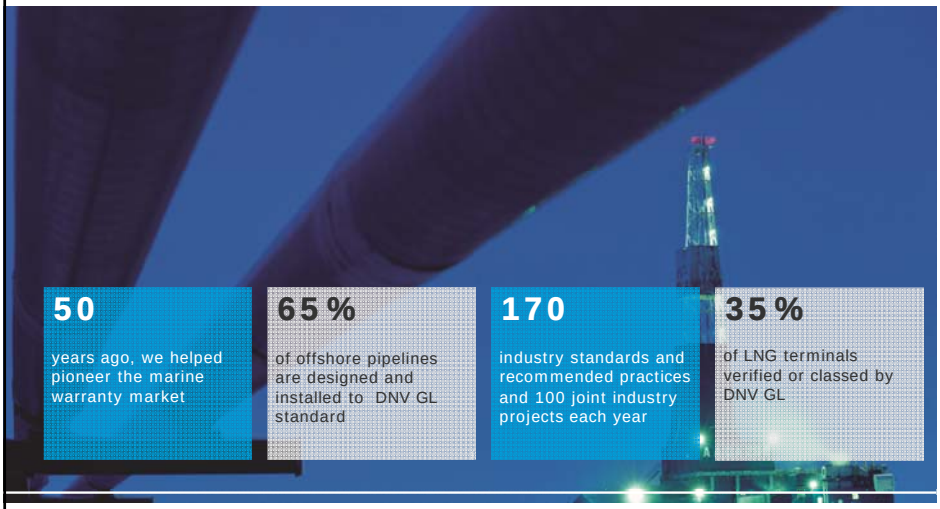

OIL & GAS


Addressing challenges in the oil and gas industry
Safety and environmental issues
Deepwater and harsh environment
Ageing assets and performance issues
Technology development
Cost pressure and standardization

Integrated services across the asset lifecycle

- Risk management advisory
- Technical advisory
- Noble Denton marine assurance & advisory
- Technical assurance – verification & inspection
- Software

Setting the benchmark in oil and gas



50
years ago, we helped pioneer the marine warranty market

65 %
of offshore pipelines are designed and installed to DNV GL standard

170
industry standards and recommended practices and 100 joint industry projects each year

35 %
of LNG terminals verified or classed by DNV GL


ENERGY


Transition to a safer, smarter and greener energy future
Increasing global demand for energy
Integration of energy markets
Climate change and extreme weather
Growing share of renewables
Security and ageing assets

Global service portfolio




Policy | Production | Transmission & distribution | Use

- Power testing, inspections and certification
- Renewables advisory services
- Renewables certification
- Electricity transmission and distribution
- Smart grids and smart cities
- Energy market and policy design
- Energy management and operations services
- Energy efficiency services
- Software

Five DNV GL development projects

1. Offshore Hybrid Power solutions

the FellowSHIP III Project

- Full scale demonstrator of a hybrid propulsion system with a Li-ion battery pack for the offshore supply vessel Viking Lady
- DNV GL Class rules for allowing the safe implementation of battery packs on ships
- Comprehensive measurement program to quantify the effect of the hybrid system
- Simulation models of power system allowing for optimization of system design and control

Li-Ion battery price and performance is a game changer

- Battery cell prices:
  - Has dropped 75% in the last 4 years
  - Expected to drop another 60% by 2020
  - Current price for cells : $500 / kWh
  - Price including installation and integration is about $1000 / kWh

- Largest installed maritime battery is 2.7 MWh (equal to 32 batteries from Tesla Model S cars)
- A 10 MWh MODU in the design-phase

- Viking Lady:
  - Capacity: ½ MWh
  - Battery weight: 5 tonnes
  - Peak power: 5 MW
  - Space: part of 20ft container (~15 m^3)

Picture: Thomas Førde, Stavanger Aftenblad

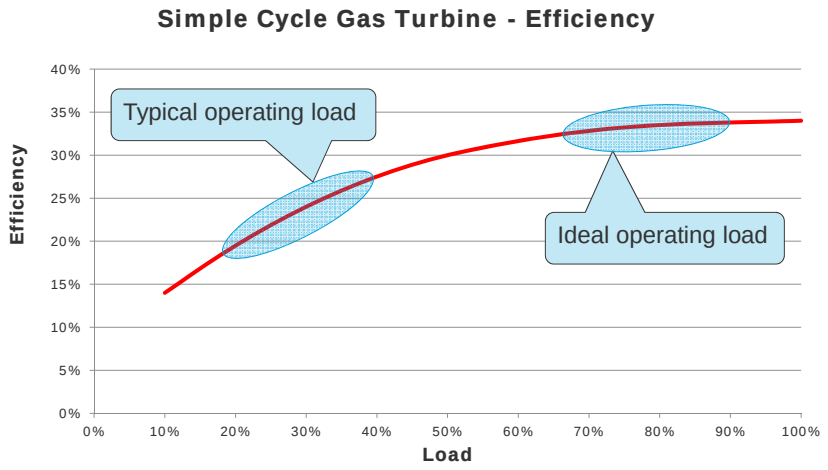
Hybrid power systems is being adopted by many industries

	Car	Ship	Drilling unit
Fuel saving with hybrid system	~10%	15%	~30-40%
Cost – (% of CAPEX)	25 %	4 %	~1-2%
Pay back period (years)	~15	~2	~1-2
Annual CO2 reduction (ton)	0.5 ton	3 000 ton *	~30 000 ton

(*Also reduces NOx by 25% and methane by 35%)

Images: Toyota Prius, Eidesvik Offshore Viking Lady, Maersk Discoverer

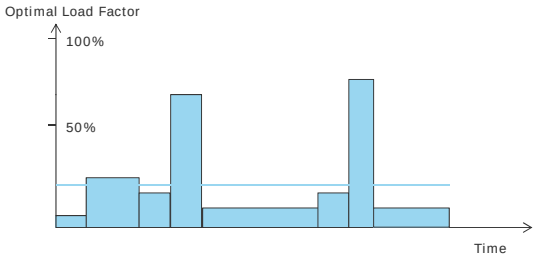
Gas Turbine Efficiency



Note: Gas Turbine with heat recovery has a typical thermal efficiency of 52% - 55%

Illustration of the benefit of hybrid solution

Typical load profile diesel engine– without battery



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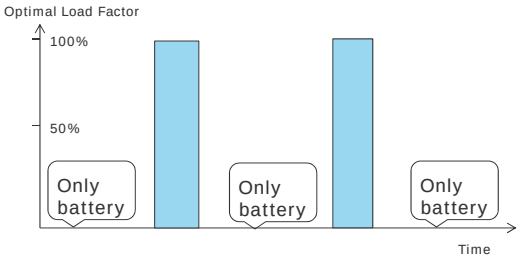


Value of Hybrid Power System

- **Reduce fuel consumption and emissions** – Up to ~40%, no noise or emissions in harbour
- **Green field development** – Reduce installed power
  - Reduce the number or size of installed generators ➔ Reduce CAPEX and OPEX
  - Free deck space – generators cover 10-15% of the available deck space
- **Brown field development** – Increase average power utilization
  - Avoid additional generators and expensive and disruptive topside modifications
- **Power system performance** – Handle high transient loads
  - Batteries can deliver instant power - very important in dynamic applications
- **Energy harvesting** – Store recovered energy in the batteries
  - From e.g. cranes or active heave draw-works used for drilling ➔ Reduce OPEX
- **Inter-connection**
  - Dimension transmission system for average load, not peak load ➔ Reduce CAPEX
- **Reliability**
  - Operate generators on steady and ideal loads, improves reliability ➔ Reduce OPEX

2. Offshore floating wind

Wind power development

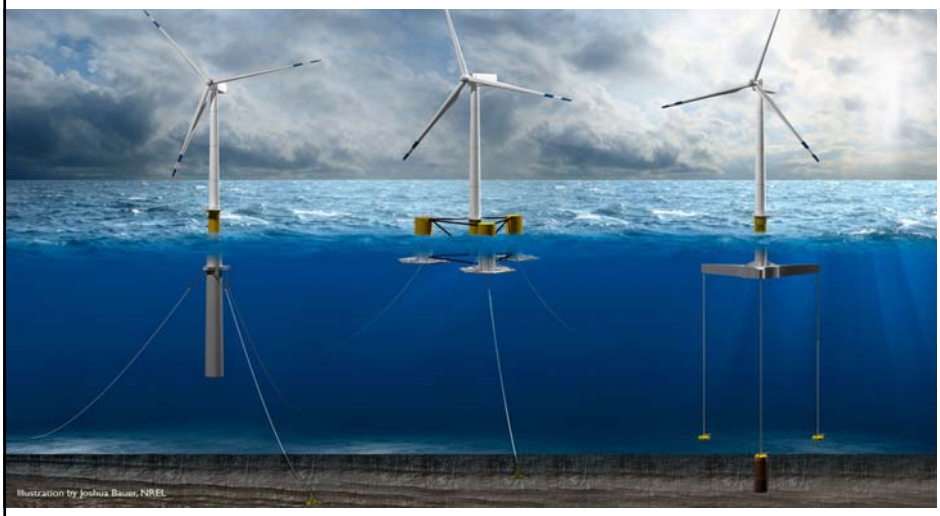
On a good site onshore, wind power is competitive with all other power generation technologies

Offshore wind power with bottom fixed structures aim to reduce cost by 40% by 2020 to reach a competitive level

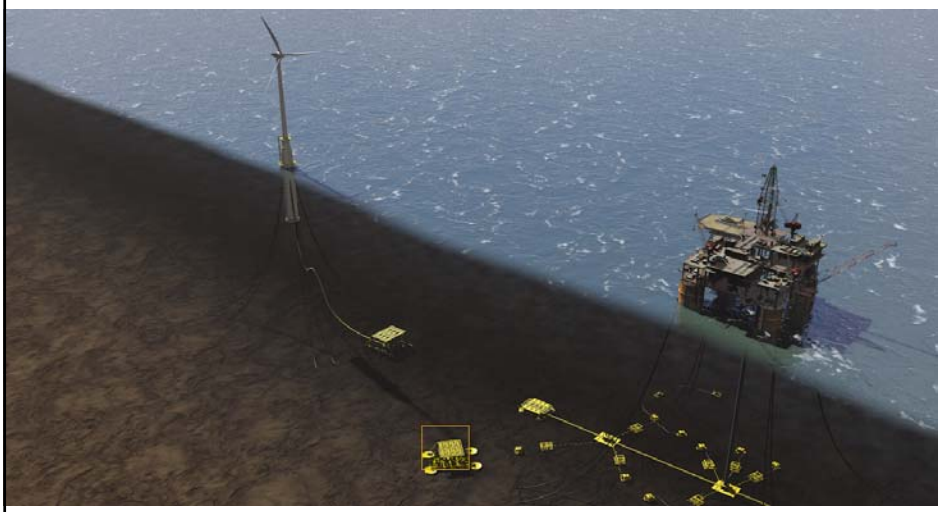
Floating wind power is at its infant stage, but powering offshore oil&gas installations is a niche where floating offshore wind is cost competitive and which can be used to drive down cost

DNV GL Offshore Wind video

Floating Offshore Wind



Water injection powered by Floating offshore wind



3. Digital technologies and automation
– a catalyst for smarter shipping

Automation in shipping: A journey 50 years old

- 1961: the first successful automated seagoing ship
  - Bridge control of the main propulsion
  - Centralized control system for machinery
  - Focus on manpower reduction

Subsea oil Production – Fully automated and remote controlled

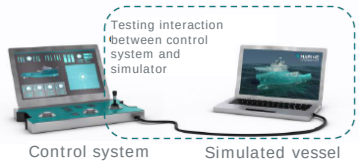
Marine Cybernetics - a control software testing pioneer in the offshore market

Traditional method of Testing

Control system in normal operations
Control software controlling **real** vessel

"New" method of Testing

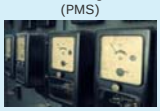
Control system during HIL testing
Control software controlling **simulated** vessel



- Hardware-in-the-Loop (HIL) the de-facto standard in **automotive** and **aviation** industries
- Develops an **independent simulator** which is a mathematical model of all related dynamic systems of the vessel or drilling rig
- The control software is thoroughly tested by evaluating how it interacts with the simulator
- Enables you to conduct a **virtual sea trial** already onsite
- Allows testing of software before installation on rig or vessel
- Allows a virtual twin throughout the lifetime

Wide range of assets and systems serviced

Testing of different control systems

Marine control systems (including on drilling rigs)	Dynamic positioning 	Steering, Propulsion, Thruster (SPT) 	Power Management (PMS) 
Drilling systems	Drill floor 	Blowout preventer (BOP) 	Intelligent Drilling/ Managed pressure drilling (MPD) 
Other automation systems	Emergency Shutdown (ESD) 	Crane 	Other computer-based control systems 

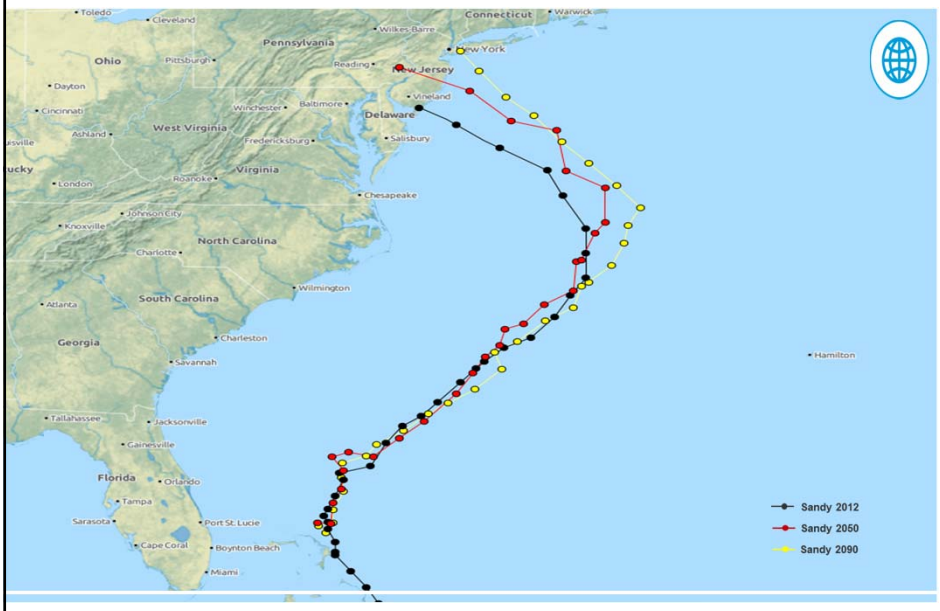
4. Adaption to Climate change

Adaptation to Climate Change - existing models fail

- Environmental design loads are estimated from time series, either measured or developed through hind casting
- Our methodology assumes
  - a stationary situation; constant mean values and variances, and
  - ergodicity; statistical parameters can be estimated from a single time series.

  These two assumptions fail when climate change effects become significant.
- For a new construction with a design life of 30-50 years, the effect of climate change must be taken into account through application of modified design loads

Adaptation to Climate Change – Sandy storm



5. Standardization

Subsea Standardization

- Industry is ordering highly customized subsea solutions
- Unable to industrialize
  - *On the agenda for many years*
- Drivers for Standardization
  - *Reduce lead time*
  - *Reduce cost*
  - *Improve quality*
  - *Make it less resource intensive*
- DNV GL wants to enable the subsea industrialization
  - *Bringing the end-user and suppliers together - to move the industry forward through JIPs*
  - *Setting boundaries - not new design standards: Complimentary to ISO and API*
  - *Standard building blocks and work processes*

Steel forgings for Subsea Applications

Situation today

- Regional differences in specifications and follow-up requirements
- Operators specific material requirements
- Supplier industry hesitant to stock raw material for own cost and risk
- Sourcing of materials in new geographies
- Hard to get company requirements to small batches

What is the motivation?

- Reduce project lead time
  - A forging delivery time typically 7 month
- Better quality and functionality
  - Large quantities increases likelihood for meeting specified requirements
- Reduce cost
  - Large quantities reduces cost

We call it the broader view

OUR VISION

GLOBAL IMPACT FOR A SAFE AND SUSTAINABLE FUTURE

www.dnvgl.com

SAFER, SMARTER, GREENER